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A

PROBATIONARY ESSAY  
ON THE  
SYNOVIAL MEMBRANE  
OF THE  
KNEE JOINT;

SUBMITTED,  
BY AUTHORITY OF THE PRÉSIDENT AND HIS COUNCIL,  
TO THE EXAMINATION OF THE  
Royal College of Surgeons of Edinburgh,  
WHEN CANDIDATE  
FOR ADMISSION INTO THEIR BODY,  
IN CONFORMITY TO THEIR REGULATIONS RESPECTING THE  
ADMISSION OF ORDINARY FELLOWS.

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BY

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&c.

*admitted 15 July 1834.*

“ Quæ compositio membrorum, quæ conformatio lineamentorum, quæ figura, quæ species, humana potest esse pulchrior? Vos, quidem, Lucili, soletis cum artificium effingitis fabricamque divinam, quam sint omnia in hominis figura non modo ad usum, verum etiam ad venustatem apta describere.”

CICERO.

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ON THE  
SYNOVIAL MEMBRANE  
OF THE  
KNEE JOINT.

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AFFECTIONS of the knee joint form so important a department of Surgery, that no apology can be necessary for making the anatomical structure, and the pathology of its capsule, the subject of a Probationary Essay. Much practical experience is unquestionably required to correct the vagueness of the knowledge drawn from books on these subjects, yet it is not less certain that such experience will be of little avail, unless it be built on an exact acquaintance with the anatomical structure of the parts concerned. It is on this account that I propose to preface the few observations I have to offer on

the pathology of the capsule of the knee joint, with a short view of its anatomical structure and its relations.

While it is impossible to deny that the anatomy of the bones, cartilages, and ligaments, that enter into the knee joint, has been correctly exhibited by many authors, I am of opinion that the descriptions hitherto given of the synovial membrane, even in the most recent works, far from bearing evidence of being drawn from a critical examination of the anatomy of the part, betray marks of having originated in a superficial dissection of the joint, or in a misplaced confidence in the accuracy of the observations made in a former age. This deficiency cannot but be regretted, whether we consider the discredit it reflects on anatomical science, or the obstacles it has offered to improvement in the pathology and treatment of the diseases of this joint. And this state of things is even more hurtful in the operative part of surgery, of which this joint is so frequently the subject, owing to the important wounds to which it is liable, inasmuch as it is seldom possible to calculate the mischief that may result from



the knife when it is used in ignorance of the precise anatomical relations and connections of the part to which it is applied.

Before entering into a detail of the attachments of the membrane in question, I shall, as succinctly as possible, point out its general configuration.

Like all other serous membranes (under which order this, as well as the membranes of the other diarthrodial joints, has been ranked by General Anatomists,) it is found to form a shut sac. In its healthy state, it has a whitish semitransparent appearance, and, when rubbed between the finger and thumb, is discovered to be very thin, and to impart a glutinous sensation. It admits of but little extension, being in this respect inferior to the peritoneum and pleura, notwithstanding the close analogy it bears to these membranes. It was Monro who first remarked the strict resemblance that exists between the synovial membranes and the serous tissues, or the lining membranes of the shut cavities of the head and trunk. We are not, however, to ascribe to this defect of extensibility in the synovial

membrane, an accident occasionally met with, I mean rupture of the membrane ; for this accident, when it occurs, must be owing fully as much to the very intimate connections between the membrane and the neighbouring bones, and to the absence of all folds that might admit of obliteration, as to the sparing extensibility of the texture.

Vesalius, whose unfortunate history is as well known as his eminence in anatomy, while in the school of anatomy at Padua, detected in the synovial membrane of the knee joint, as well as in those of the other articulations, adipose pellets, which he regarded as the glands of these membranes. Though it is certain that Vesalius pointed out these, and also that Etienne described them, yet the merit of the discovery is usually given to Havers, whose name they bear at present, being called the Glands of Havers. They are in a great measure composed of fat, and the variety exhibited in their appearance in different instances, depends on the greater or less proportion of that substance contained in them. They are situated chiefly on the outer surface of

the capsule of the knee joint, though, on many parts of its interior surface, they are distinctly discoverable.

Notwithstanding the attention bestowed on these bodies by many eminent anatomists, among whom are Cooper and Monro, their structure and uses have been hitherto but imperfectly explained. Down to the time when Monro took up the investigation of this subject, they were generally regarded as glands, from which the synovial fluid so liberally supplied to this joint was derived. That they are of a glandular structure has not been disproved : it is true no ducts have been detected leading from them to the cavity of the joint, yet, when it is considered how imperfectly their structure is known, we must acknowledge that little evidence against their glandular character is furnished by that circumstance. If we consult Heyleger's Dissertation \* we shall find him favourable to the old opinion maintained by Havers, and I believe the same opinion begins to revive amongst other anatomists.

\* *Dissertatio Physiolog. Anatom. de Fabrica Articulorum.*



When we consider the strict analogy between the synovial membranes, as, for example, the one under consideration, and the serous tissues, such as the pleura and peritoneum, it is perhaps impossible to maintain that the secretion can be derived from glands in the former, while in the latter it is derived solely from the membranous surface, yet, since the synovia differs from the serous secretion, in being of a mucilaginous and lubricating nature, which it owes to the presence of some unknown animal principle, it is not improbable that the bodies in question may afford that part of the secretion on which its lubricity depends, while the vessels of the membranous surface furnish a fluid entirely similar to that of the common serous cavities. Thus the perspiration derives its fatty nature, not from the same vessels that exhale its thinner part, but from the sebaceous glands of the skin. But, in an Essay of this kind, it will hardly be proper to enter farther into such a discussion.

The synovial fluid, however, requires a few words on its own account: it is disco-



vered on opening the sac, the internal surface of which is smooth, oily-looking, and transparent. This fluid was well known to the Alexandrian School as the *μυξα των αρθρων*. Even then much labour was bestowed on the examination of its nature, and it has in recent times engaged the attention of many physiologists and chemists, among whom are Margueron, Fourcroy, J. Davy, Hildebrandt, and Orfila. In its usual state, it is a somewhat viscid fluid, and assumes a gelatinous appearance on being exposed to the atmosphere. It consists of water, albumen, and a fibrous matter that may be precipitated by the dilute mineral acids, and by acetic acid: it also contains the salts usually found in the animal fluids. From what was said above, it appears that physiologists are not all agreed as to the exact source of this secretion. Analogy leads us to believe that it is an exhalation from the whole surface of the membrane, or at least that such is the principal source of it. While, however, the entire subject of secretion is wrapped in obscurity, we are not likely to come to sound conclusions by the consideration of

any single secretion. Whatever be the source of the fluid, it is under the influence of the absorbents, so that the quantity contained in the joint, so long as it continues in a healthy state, is at all times tolerably uniform.

There is no articulation in the body possessed of so large an extent of synovial surface as that under consideration; and if we reflect but for a moment how complex the bones and cartilages, and how numerous the ligaments are, that enter into the knee joint, with all of which the membrane is more or less intimately connected, we shall readily conceive that its relations must be extremely intricate. It cannot be denied, however, that the difficulties of this subject have often been increased, rather than cleared up, by the laboured descriptions of some anatomists, and that the progress of our knowledge here, as in so many other parts of the body, has been much retarded by the desire of novelty occupying the place of that rigid deference to the authority of simple observation, which ought to characterize all anatomical researches.

The best mode, perhaps, of tracing the sac, is to begin at its external border on the femur, a space defined by the articulating surface of that bone. From this it may be followed inwards, in all directions, to the margin of the fossa between the condyles. The whole membrane is concentrated at this point, and leaves the femur to pass downwards and forwards to the inferior part of the surface of the patella, where a large quantity of adipose substance separates it from the patellar ligament. The name of *ligamentum mucosum* has been appropriated to the portion of membrane extending between the femur and the patella. This part forms a sort of canal not unlike the tube of a funnel, and is connected with much adipose tissue. From below, upwards along the posterior surface of the patella, the membrane ascends to the posterior aspect of the quadriceps tendon, where it becomes enlarged, and returns to the articulating surface of the femur from whence we began to trace it.

From the insertion of the *ligamentum mucosum*, it passes backwards over the semilunar cartilages, to which it is intimately and,



I may say, inseparably connected. Some eminent anatomists have indeed denied that these cartilages are covered by it; but Nesbitt, Bonn, and William Hunter, long since proved that it is extended over their surface.

While it is passing from before backwards, the synovial membrane becomes attached to the crucial ligaments, both of which it nearly covers. It also adheres to the posterior ligament of Winslow, and lines the articular aspect of both heads of the gastrocnemius. Passing along these parts, it again arrives on the posterior part of the articulating surface of the femur. It may now be traced laterally towards the fibula, on the one hand, and, on the other, to the internal margin of the tibia. On the inner side, it passes along the internal lateral ligament; and as the anterior edge sometimes presents a duplicated appearance, it has obtained the name of alar ligament. In this direction, then, it reaches the inner condyle of the femur. It now remains to be traced outwards; and here the observations of anatomists have evidently failed of success, as the extent and connections of the synovial capsule in this direction



have been hitherto incorrectly described. On referring to works of anatomy, we shall find it stated that the membrane passes over the superior tibio-fibular articulation, along the external lateral ligament, invests the tendon of the popliteus, and arrives on the thigh-bone from which we began to follow it. It, however, passes along the external surface of the head of the tibia, and dips almost to the bottom of the articulation between that bone and the fibula, rising again along the side of the latter, whence it extends to the external condyle of the femur, and forms between these two last mentioned bones the external alar ligament, so called in contradistinction to that before described under the name of internal alar ligament.

In 1829, I submitted this connection of the synovial membrane of the knee joint with the superior tibio-fibular articulation, to the better judgment of my learned and talented friend, Professor Lizars, who, with a readiness superior to any petty feeling of jealousy, acknowledged the importance and originality of the observation, and quickly applied the discovery to practical use, by

founding on it a better mode of amputating the leg than that usually followed.

Having, since that time, had ample opportunities of ascertaining the universality of this anatomical fact, and the extent of the practical benefits resulting from the knowledge of it, I now embrace this opportunity of giving it publicity among my professional brethren.

From the description just given of the course of the synovial membrane, and of its connexions with the several parts of the articulation, it must appear that, like the peritoneum, or any serous membrane, it may be traced from any given point throughout its whole extent back to the same point. Accordingly, though no two anatomists agree in the particular mode in which they trace out its course, all concur in assigning to it the same general plan of disposition.

#### MUSCLES.

There is no muscle proper to the capsule of the knee joint, the sub-crural or capsular excepted. This muscle is seldom wanting,

and seems to be calculated solely for the protection of the synovial membrane. It may be seen after the division of the two vasti, the rectus, and the cruræus, under which latter muscle it is placed, being separated from it by a thin layer of cellular tissue. It arises from the upper part of the inferior fourth of the femur, passes downwards and forwards to be inserted into the synovial membrane under the cruræus. This muscle is fleshy throughout, and seems to be of use in raising the capsule in extension of the leg, and thus preventing it from being bruised between the opposed surfaces of the bones. Though this be the only muscle peculiar to the capsule, several others are in connection with it; these are, posteriorly, the semi-membranosus, popliteus, and gastrocnemius; anteriorly and laterally, the cruræus and vasti.

#### ARTERIES.

The blood-vessels with which this articulation is so amply supplied, come next to be considered. The first of these is the anastomotica magna, given off from the femoral



artery before that vessel has perforated the triceps to become popliteal. It descends towards the inner side of the joint, affording three or four branches to the muscles, and then pursues its course along with the saphenus nerve, and reaches the knee, where it anastomoses with the other vessels of the membrane. This artery supplies both the external and internal surface of the articulation with a very considerable quantity of blood. In some subjects, several branches derived from the femoral supply the place of the *anastomotica magna*.

The next branches come from the popliteal : of these, the *Ramus profundus* of the *arteria articularis superior externa*, comes first to be mentioned. The latter artery, springing from the outer side of the popliteal, and passing upwards and outwards above the external condyle of the femur, twists round this bone to reach its anterior surface. At this point it gives off the *Ramus profundus*, which, besides supplying the synovial membrane, sends several branches of inferior magnitude into the femur, at the border of its cartilage. This artery inosculates freely



with the other arteries of the membrane, and more particularly with the *Ramus profundus* of the *arteria articularis superior interna*; the artery which comes next to be considered.

From the inner side of the popliteal artery, above the condyle of the femur, the *arteria articularis superior interna* comes off; this vessel, from its origin, runs close to the bone, passing under the *vastus internus* and *adductor magnus*. It then gives rise to the *Ramus profundus*, which passes directly to the synovial membrane, and communicates freely with the former artery. By a careful search, a few delicate twigs from this vessel may be traced into the substance of the femur; so that it closely resembles the last described artery in origin, course, and termination.

Opposite the bend of the joint, from the anterior or articular surface of the popliteal artery, the *arteria articularis media sive azyga* arises. This vessel is so named from occupying the centre of the articulation, and, having no fellow, perforates the ligament of Winslow, and immediately divides into numerous branches for the supply of the synovial membrane, while a few are transmitted to

the crucial ligaments, and to the adipose tissue at the posterior part of the joint.

In a well injected subject, a few branches proceeding from the *arteria articularis inferior externa* and *interna*, may be traced to the membrane under consideration, but these are so inconsiderable as hardly to merit attention.

The only artery that remains to be noticed is the *arteria recurrens* of the anterior tibial. This vessel is of considerable size and importance, and is the first branch of the anterior tibial, sent off immediately after that artery has perforated the interosseous space between the tibia and fibula. It perforates the fibres of the *tibialis anticus* and *peroneus longus*, pierces the tendinous aponeurosis which envelops the leg, and arrives at the upper and outer part of the tibia. Though this artery is not destined solely for the nourishment of the interior of the joint, no small proportion of its branches are devoted to that purpose. They are found to enter the articulation at the outer surface or edge of the *ligamentum patellæ*, and to traverse the mucous or inner surface of that ligament.

Such, then, is a general outline of the vessels supplying this membrane with blood; and if we take into consideration their numbers, course, and inosculations, together with the great extent and intricacy of the membrane itself, it must be granted that an urgent necessity exists for the careful study of this articulation.

#### VEINS.

The blood conveyed to the membrane by the arteries just described, is returned by numerous small veins, most of which terminate on the lateral and articular aspects of the popliteal vein. The complex course, numbers, and anastomoses between these vessels, render the dissection of the popliteal space intricate, yet, since this is so frequently the seat of operations, they claim an adequate share of attention.

#### NERVES.

It is no less surprising than true, that no nerves are discoverable, either in the syno-



vial membrane of the knee, or in any of the serous membranes. I have bestowed much time on efforts to follow them into these tissues, yet with no better success than had attended the previous attempts of others. Some other method, it must be presumed, than the knife must be had recourse to, before our endeavours prove successful.

#### LYMPHATICS.

The lymphatics of this membrane are numerous, and often distinct; they pass chiefly towards the popliteal space, and enter the lymphatic glands in that district.

#### SURGICAL OBSERVATIONS.

Having said thus much on the anatomy of the synovial membrane of the knee joint, I proceed next to make a few remarks on the surgery of this part of the body. Wounds of the capsule, with their consequences, will exhaust all the space that an Essay of this sort permits to be devoted to the subject.

In whatever way the synovial capsule of the joint is wounded, a discharge of synovial fluid never fails to take place.



This deserves the attention of every practitioner, inasmuch as the discharge in question is a valuable guide to him in the diagnosis, prognosis, and treatment of injuries of the articulation. This discharge may be regarded as an unfailing symptom in every case of wounds of the capsule, as often at least as the position of the limb is favourable for the exit of the fluid. Yet this symptom is not free from fallacy, since all our attention may sometimes be insufficient to show whether the fluid comes from the synovial capsule itself, or from some of the neighbouring bursæ that may have been wounded. I have myself known several cases where injuries of the synovial bursæ, (owing to this cause,) have been mistaken for injuries of the capsular membrane. Boyer\* tells us of several cases in which a fluid resembling synovia, was discharged from wounds of the sheaths of tendons.

Where such a difficulty occurs, the probe will be found of great service for determining the nature and extent of the injury.

\* *Traité des Maladies Chirurg.*

The objections urged against the use of this instrument in such cases, although founded on reason, are often carried to a pernicious extent: and I would certainly recommend that advantage be taken of it, as tending to add certainty to the diagnosis. The use that may be made of the information it affords must more than counterbalance the bad effects of employing it, unless where caution is disregarded.

Another danger to be apprehended from laying open the knee joint, is in the inflammation so apt to follow lesions of this capsule. The extent of this inflammation will in some measure depend on the constitution and state of the patient, although still more on the nature of the injury, according as the wound is incised, punctured, or lacerated.

The best authenticated records of Surgery show that different results have followed injuries, apparently similar, in this part of the body; still, though it cannot be denied that the membrane has been severely injured with little or no bad effect, the works of Boyer, Brodie, Hey, &c. prove that such is not usually the case, but that wounds or in-

cisions into this articulation ought to be dreaded as of the greatest danger ; that life itself has often fallen a sacrifice to them, or that, where the result has not been fatal, amputation has generally become necessary.

Brodie tells us that the usual consequences of inflammation are, an effusion of lymph into the cavity of the joint, thickening of the synovial membrane ; the conversion of it into a substance like gristle, and an effusion of coagulable lymph, and probably of serum, into the cellular structure.

If the inflammation runs high, and fails to be subdued, the formation of pus will be the probable result, ulceration will follow, and a purulent discharge will take place by the original opening, if any existed ; or if not, pus will make its way to the surface by ulceration. Such, then, are not unfrequently the effects of injuries of the capsule, from whatever cause they may have originated.

The danger of wounds, and the tendency to inflammation, in the synovial capsule, suggest some observations on the ordinary mode of performing amputation below the knee joint. In this operation, it has been recom-



mended, and become a general practice, to excise the head of the fibula. Now, from what has been stated relative to the extent of the synovial membrane, it is evident that the bone cannot be removed without laying open extensively the cavity of the joint, and giving rise to the usual bad consequences of wounds of this capsule. In fact, a copious discharge generally follows the operation, tedious suppuration comes on, and occasionally the ill-fated patient sinks exhausted. And where the fatal event does not occur, how often have we slow, and tedious recoveries, terminating in useless ankylosed joints, rendering the stumps of little service?

Such an operation should then be at once abandoned, and the fibula cut across along with the tibia; and I am happy to say that this practice has already been adopted by some of the most eminent surgeons in this city.

The treatment of injuries of the synovial membrane, since they are followed by so many bad consequences, deserves the most serious attention. As these bad effects must be all comprehended under inflammation and its consequences, it will be at once evident to the



least experienced, that the antiphlogistic treatment is rigorously called for. A few words, then, on the several methods of conducting the antiphlogistic treatment, in such instances, will properly close this Essay.

Detraction of blood stands at the head of the means fitted to afford relief in such cases. It may be necessary to practise it generally as well as topically. Leeches will be required in almost every instance of such injuries, and are to be applied in sufficient numbers to abstract a considerable quantity of blood, and, when they fall off, the discharge from the wounds is to be kept up by fomentations as long as possible. The propriety of taking blood from the arm, the extent to which the venesection is to be carried, and the number of times it is to be repeated, must be determined by the nature of the injury, by the age, strength and constitution of the patient, by the state of the pulse, and above all, by the intensity of the inflammation.

It is hardly necessary to insist on the most perfect rest being enjoined ; while the limb is supported in such a manner as best favours the return of the blood by the veins. There is

no part of the plan of treatment recommended in inflammation of the extremities that better deserves our attention than the last mentioned. The benefits resulting from it are, I think, amply established by the practice of Sir A. Cooper ; and, if the limb be not supported, all our other remedies will often prove unavailing, the disease proceeding from bad to worse, until the patient at last sinks under it.

Many other local remedies besides leeches may be resorted to, due care being taken to regulate the employment of them according to the circumstances of the case. Cold applications, I may state, are not always equally efficacious ; their effect, in some cases, being far inferior to what might have been expected from their usefulness in others. In some indeed, cold appears to disagree entirely with such affections, while a marked advantage attends the use of warm fomentations. Under this difficulty, the feelings of the patient fortunately prove a secure guide to the kind of application best fitted to counteract the existing morbid action.

When there is an opening in the capsule,

proper measures must be taken to secure the reunion of the edges as speedily as possible.

It would be as tedious as unnecessary, to enumerate all the remedies that have been found of service in inflammations of this membrane.—All of them belong to the general treatment of inflammatory action in the tissues of the body.—Of the counter-irritants that are most useful, I may particularize the Moxa\* and Potassa fusa.

After the inflammation has subsided, the articulation is often left insufficient for its ordinary action, being stiff or immoveable, owing to thickening of the capsule and adjacent parts. To remedy these evils, no small care is frequently requisite ; but, for the proper management of such cases, I must refer to the writings of Brodie, Buchannan, &c.

\* I have employed the Moxa rather extensively, during the last four years, as a counter irritant, in obstinate cases of chronic inflammation of the liver, and with a success that has induced me to notice the fact in this place.

FINIS.















